

*DUDLEYA CALCICOLA* (CRASSULACEAE), A NEW SPECIES  
FROM THE SOUTHERN SIERRA NEVADA

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ABSTRACT

A new species, *Dudleya calcicola*, is described from the southern Sierra Nevada in Kern and Tulare Counties, California. The xeric limestone habitat, associated species, and ecological adaptations of the plant are discussed.

Recent explorations of the xeric limestones of the southern Sierra Nevada yielded a new *Dudleya*. Although Katharine Brandegee reportedly was intent on describing this plant from collections made by C. A. Purpus (Purpus 1897a,b), she failed to do so. Moran (1951) noted that the Purpus collections had narrower leaves than *D. cymosa*; however, he did not recognize these collections as distinct. Nevertheless, we believe a combination of vegetative and floral features separate *D. calcicola* from *D. abramsii* and *D. cymosa*.

***Dudleya calcicola* Bartel & Shevock, sp. nov.**

Caudex ramosus caespitosus rosulas compactas increbre producens. Folia glauca vel pulverulenta lanceolata. Inflorescentia ex ramis patulis plerumque denuo ramificantibus constans. Flores duo usque ad octo per cincinum, pedicellos 1–6 mm longi terminantes. Petala anguste acutata flava haud rubrotincta apicibus valde extrinsecus curvatis (Fig. 1).

Plants to 1.5 dm wide, of 5–20 or occasionally 50 densely packed rosettes. Caudex short, 1–2 cm thick, simple or frequently caespitously many-branched. Rosettes 1–9 cm in diameter of 10–20(–30), with erect or ascending leaves. Rosette leaves oblong-lanceolate or tapering from base, acute to acuminate, infrequently apiculate, 1–8(–10) cm long, 3–13(–16) mm wide, 2–5 mm thick, pruinose to pulverulent to glaucous, glaucescent in age; ventral surface slightly convex on smaller rosettes but usually plane or concave and frequently somewhat sulcate; dorsal surface convex, the margins rounded except towards base; base

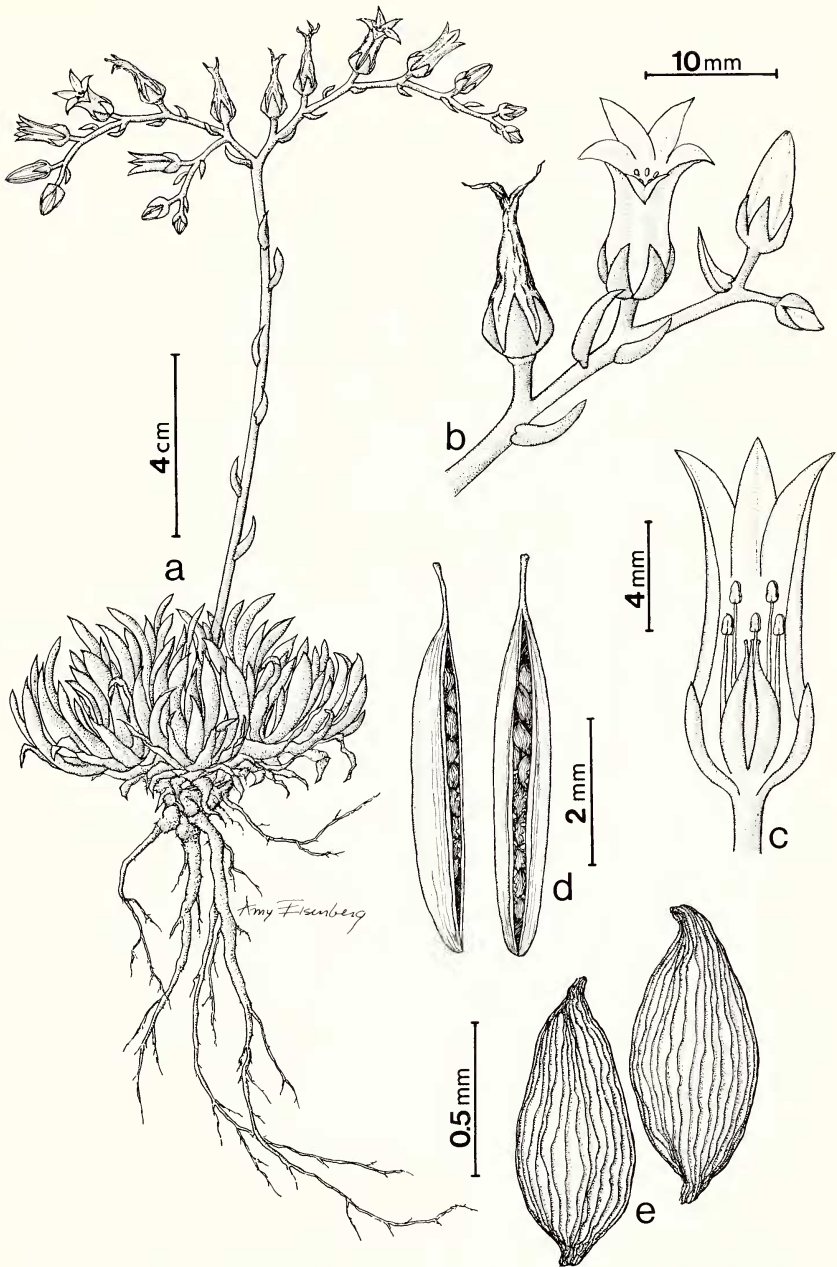


FIG. 1. *Dudleya calcicola*. a. Flowering habit with cespitosely many-branched rosettes. b. Inflorescence. c. Flower with two petals removed. d. Carpel with seeds. e. Seed. All from Shevock 8728 and 8802.

5–10(–13) mm wide. Floral stems erect, glaucous, 3–18(–25) cm high, 1.5–4(–4.5) mm thick, naked in the lower 1–7 cm, with 5–20 usually spreading glaucous leaves, triangular lanceolate, acute to acuminate, the lowermost 4–20 mm long, 2–10 mm wide. Inflorescence obpyramidal, of 2–4 ascending to mostly spreading branches that rebranch 0–3 times; cincinni circinate, in age spreading to rarely ascending, 1–6 cm long with 2–8(–10) flowers; pedicels ascending to erect, 1–6(–8) mm long, 1–1.5 mm thick at base, slightly thickened upward. Calyx subtruncate to rounded below, 3–7 mm long, 3–7 mm wide, the sepals appressed, triangular-ovate to lanceolate, acute, 2.5–6 mm long, 2–4 mm wide, usually glaucescent to glaucous. Corolla straw-colored to mostly pale yellow with darker yellow on petal keel, 9–15(–18) mm long, 3.5–5(–6) mm thick, the petals connate 1–3 mm, erect with tips strongly outcurved especially in age, lanceolate to usually narrowly acute, 2–4(–4.5) mm wide. Filaments straw-colored to pale yellow, the epipetalous 3.5–6 mm long, adnate 1–3 mm, the antesealous 4.5–7.5 mm long, adnate 1.5–4 mm; anthers yellow, 1–1.5 mm long. Nectaries white to yellowish, 0.5–1.3 mm wide. Gynoecium 3–5(–7) mm high, 2–3 mm thick, the carpels erect, appressed, slender, tapering into styles ca. 1–2 mm long; seeds 7–18 per carpel, 0.7–1 mm long, brown, striate-reticulate. Chromosome number:  $n = 17$ .

TYPE: USA, CA, Tulare Co., Kern River at Roads End, T23S R32E S13, Sequoia Natl. For., 1220 m, 11 Jul 1981, *Shevock 8802*. (Holotype: CAS; isotypes: FSC, NY, RSA, SBBG, SD, UC.)

PARATYPES: USA, CA, KERN Co., rocks, Walker Pass, Apr–Sep 1897, *Purpus 5402* (UC, US); rocks, Pahute [sic] Peak, Apr–Sep 1897, *Purpus 5192* (UC, US); w. of Cane Cr., T26S, R32E, S25, 13 May 1981, *Bartel 1023* (UC) and 27 Jun 1981, *Bartel 1034* (UC); divide between Erskine and Bodfish Creeks, T27S R33E S8, 17 Apr 1981, *Shevock 8254* (CAS) and 13 May 1981, *Shevock 8468* (CAS); Long Canyon, T27S R34E S4, 26 Apr 1981, *Shevock 8467* (CAS); Sand Canyon, T30S R33E S22, 25 Jul 1981, *Shevock 8848* (CAS); 3 km n. of Twin Oaks along Caliente Creek Road, T30S R33E S12, 25 Jul 1981, *Shevock 8851* (CAS, RSA). TULARE Co., Kern River (near Johnsondale Bridge), 4 Jun 1939, *Lewis s.n.* (LA); Brush Creek Canyon, 13 May 1968, *Howell & True 44347* (CAS); Kern River Canyon e. of Limestone Campground, 14 May 1969, *Howell & True 45761* (CAS); Kern Plateau near Rincon Trail, T22S R33E S30, 15 May 1981, *Shevock 8500* (CAS, RSA); Packsaddle Cave, T23S R33E S7, 7 Jun 1981, *Shevock 8728* (CAS).

*Dudleya calcicola* is distinguished from other species by a combination of morphological characters. The caudex of *D. calcicola* is typically cespitosely many-branched with as many as 50 densely packed rosettes. Conversely, *D. cymosa* exhibits a simple or few-branched caudex (Moran 1951). The narrow, glaucous to pulverulent leaves and

short pedicels of *D. calcicola* are similar to those of *D. abramsii*. However, the foliar bloom is generally much heavier and the pedicels are slightly longer in *D. calcicola* when compared to *D. abramsii*. The inflorescence, like that of *D. cymosa*, is usually somewhat obpyramidal with relatively short spreading cincinni. Although the floral stem of *D. calcicola* is occasionally bifurcate as in *D. abramsii*, the stem is thicker and the cincinni generally are spreading rather than ascending. The petals of *D. calcicola* also lack the red flecks and/or red lineolate keel typical of *D. abramsii*. The narrowly acute petals resemble those of *D. cymosa* subsp. *cymosa*, but they are generally more strongly outcurved and are slightly longer in maturity. Although the narrow leaves and pale yellow flowers of *D. calcicola* are similar to some populations of *D. cymosa* subsp. *setchellii*, these populations, confined to serpentine grassland within the Santa Clara Valley in Santa Clara County, have longer cincinni that support twice the number of flowers in *D. calcicola*. Moreover, these populations have erect cincinni and lack the narrowly acute petal apices typical of *D. calcicola*.

In many respects *D. calcicola* is intermediate between *D. abramsii* and *D. cymosa*, although it seems slightly closer to *D. abramsii*. This could account for the difficulty in determining where to place *D. calcicola* in the past. Nevertheless, the combination of morphologic features of the species and characteristic limestone habitat make *D. calcicola* readily distinguishable.

*Dudleya calcicola* occurs predominantly on pre-Cretaceous limestones (Smith 1965) within chaparral or pinyon-juniper woodland at 850–1700 m. Extensive field searches on adjacent Mesozoic granitic, Mesozoic basic intrusive, pre-Cretaceous metamorphic, and pre-Cretaceous metasedimentary rocks (Smith 1965), have located only a few populations of *D. calcicola* in the Kern River watershed generally east of Lake Isabella. Thus, the species seems to be restricted primarily to isolated limestone ridges and steep slopes. The habitat of this *Dudleya* is the basis for the specific epithet, which also provides a good vernacular name: limestone live-forever.

Populations of *D. calcicola* are scattered over a relatively large area of the southern Sierra Nevada from the Rincon area south of Durrwood Creek in Tulare County to the southern Piute Mountains near Caliente Creek in Kern County (Fig. 2). The total area of limestone habitat, however, is quite restricted and isolated. Several species are associated with all the surveyed *D. calcicola* populations occurring on limestones. These species include: *Delphinium purpusii*, *Ephedra viridis*, *Eriogonum fasciculatum* subsp. *polifolium*, *Eriogonum saxatile*, *Eriophyllum confertiflorum*, *Fremontodendron californicum*, *Happappus linearifolius*, *Notholaena jonesii*, *Selaginella asprella*, *Stephanomeria pauciflora*, and *Yucca whipplei* subsp. *caespitosa*. Associ-

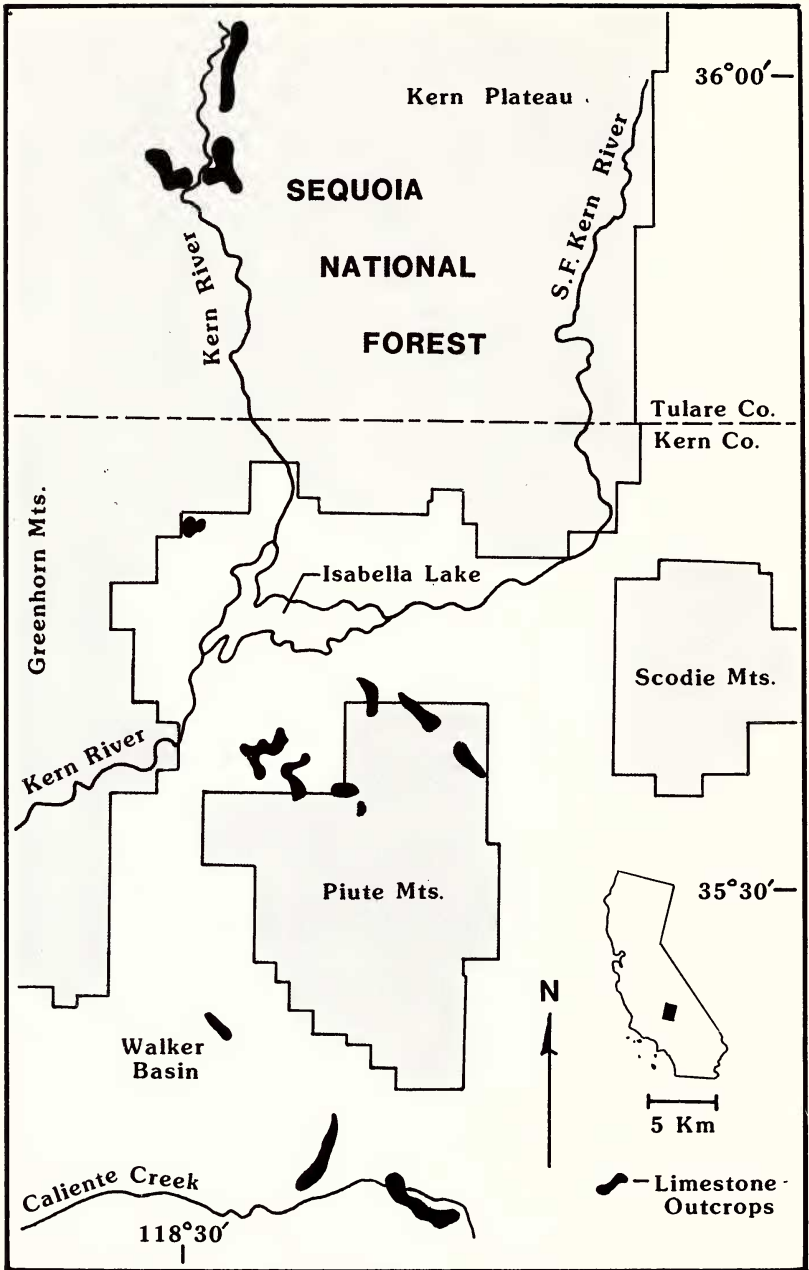


FIG. 2. Geographic distribution of *Dudleya calcicola* on limestone outcrops, southern Sierra Nevada.

ated with *D. calcicola* in the northern Piute Mountains are several plants that are usually found in the desert regions east of the Sierran crest. These species are: *Cheilanthes viscida*, *Ephedra nevadensis*, *Forsellesia nevadensis*, *Purshia glandulosa*, *Salvia dorrii*, *Tetradymia axillaris*, and *Tetradymia stenolepis*.

The densely glaucous leaves of *Dudleya calcicola* are typical of dudleyas growing on open rock outcrops (Mulroy 1979). Glaucescence, a genetically controlled feature, enables the leaves to reflect a great percentage of the ultraviolet, visible, and near-infrared radiation and thus reduce ultraviolet damage and desiccation (Mulroy 1979). The heavy glaucous leaves probably enable *D. calcicola* to occupy these xeric limestone habitats; a less glaucescent form of *D. cymosa* (Lemaire) Britton & Rose grows nearby in more mesic sites along the banks of the Kern River. Although glaucescence may have other adaptive properties (Mulroy 1979), the density of the bloom in *D. calcicola* appeared to intensify in summer even under cultivation. This suggests that glaucescence is affected at least partially by the level of light. Although Denton (1982) reported that substrate may effect changes in glaucescence in *Sedum*, this was not observed with cultivated specimens of *D. calcicola*. In addition, the unusual dwarfed cespitose habit of *D. calcicola* recalls "cushion plants" of alpine environments. This growth form, too, may buffer the plant from summer drought and high light levels prevalent on the limestone outcrops. Nevertheless, the dwarfed habit is evidently environmentally controlled to some degree, because many plants growing on deeper soil, in partial shade, or in cultivation are obviously more robust.

Carl A. Purpus was first to collect this *Dudleya* and to distinguish it from the widespread *D. cymosa*. In a letter of 23 May 1897, Purpus wrote Katharine Brandegee (UC) that he had collected an "*Echeveria* [*Dudleya*], which is all together different from *E. purpusii* [*D. cymosa* subsp. *cymosa*]." He further noted its smaller leaves, straw-colored flowers, and limestone or granite habitat. Later, Purpus (1897a,b) wrote that the plant would shortly be described by Mrs. Brandegee in the journal *Erythea*; but neither she nor her husband T. S. Brandegee (who named *Delphinium purpusii* and *Penstemon purpusii* in 1899) ever described it.

Moran (1951) in his revision of the genus placed the Purpus collections with *D. cymosa* subsp. *cymosa*. However, he noted the narrow leaves and suggested that some of the dudleyas from the southern Sierra Nevada might belong better with *D. cymosa* subsp. *setchellii* (Jepson) Moran. Others, however, have anonymously annotated the various collections of *D. calcicola* as *D. abramsii* Rose, *D. saxosa* (M. E. Jones) Britton & Rose, and *D. cymosa*.

*Dudleya calcicola*, because of its erect petals and pistils, is placed in the subgenus *Dudleya*. Buds fixed in the field on 17 April and 13 May 1981, *Shevock 8254* and *8467*, yielded a meiotic count of  $n =$



17. This number is basic for *Dudleya* (Uhl & Moran 1953), and thus the species is a diploid.

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